have sharp blades that smooth and shape wood. A *wood-turning lathe* shapes wood into rounded forms by rapidly spinning it against a cutting edge held by the operator. A *file* shapes wood in places where a sharper cutting tool does not fit. Files can also be used to sharpen tools.

Boring enables a woodworker to connect sections of wood with *screws*, *metal plates*, *hinges*, and *joints*. *Braces* and *hand drills* have bits to make holes of different sizes for various purposes. For example, one kind of bit bores holes for *dowel joints*. These joints connect two sections of wood with a wooden peg that fits tightly into holes drilled in each section. *Portable electric drills* and *drill presses* also use bits to bore holes. These machines have attachments for sanding and other uses as well.

Fastening. Sections of wood are fastened together with metal fasteners, such as *screws* and *nails*, and with *adhesives*. Tools for fastening include *screwdrivers* and *hammers*. Screwdrivers insert screws that connect sections of wood and hold hinges and metal plates. Hammers drive in nails and other types of metal fasteners.

Gluing is one of the oldest methods of fastening sections of wood, and a variety of adhesives are used in woodworking. *Polyvinyl resin emulsion glue*, or white glue, can be applied directly from the bottle. It should not be used if it will come in contact with water or high temperatures. *Urea-formaldehyde resin glue* and *resorcinol formaldehyde resin glue* both must be mixed by the user. Urea glue can resist cold water for short periods, but it cannot withstand high temperatures. Resorcinol glue is waterproof and heat resistant.

After gluing, wood should be put into *clamps* for as long as 12 hours. The length of time depends on the temperature, the kind of wood, and the type of glue. Clamping holds the wood in place and spreads the glue into the pores.

Sanding and Finishing. Sanding removes tool marks and makes wood surfaces smooth for finishing. Sanding should not begin until the wood has been cut to its final size. Most *sandpaper* manufactured for use by hand has rough particles of the minerals *flint* or *garnet*. *Aluminum oxide* is a common sanding material used in such machines as a *portable belt sander* or a *vibrating sander*. Portable belt sanders work better than vibrating sanders on large wood surfaces.

Woodworkers use a variety of *finishes* to protect wood and to bring out the beauty of the grain. A *stain* is a dye that colors wood without hiding the pattern and feel of the grain. *Paint* covers the grain of the wood and provides a color of its own. *Varnish*, such as *lacquer* and *shellac*, gives wood a hard, glossy finish. *Wax* protects varnish and has a smooth, shiny finish when polished. *Enamel* is a varnish paint.

Tool Care and Safety

Tools are made to be safe when used correctly. They can be preserved—and accidents can be prevented—by using the right tools for the job and keeping them clean and sharp. A woodworker must use extra pressure with a dull tool, and injury could result if the tool slips. Many tools can be sharpened on the rough surface of an *oilstone*. A broken or damaged tool does not work properly and should not be used.

Whenever possible, wood should be held in a vise or by clamps, so that both hands are free to handle the tool being used. Floors should be kept clean of such substances as sawdust and finishing materials, which are slippery and also could catch fire. Safety glasses should be worn during cutting and boring operations to protect the eyes from flying particles of wood. Loose clothing and jewelry that could get caught in a machine should not be worn in a woodworking area.

A craftsman can prevent accidents by holding a portable power tool until all the moving parts have stopped. A machine should never be left running unless the operator is present, and it should be disconnected when not in use. The hazard of electric shock can be reduced by connecting *ground wires* to machines that have not been previously grounded.

Wood for Woodworking

Woodworkers classify wood as *hardwood* or *softwood*, depending on the type of tree from which it comes. Most hardwood trees are *deciduous*—that is, they lose their leaves every autumn. Most softwood trees, called *conifers*, have narrow, pointed leaves and stay green the year around. However, this classification system does not indicate the hardness of wood because various softwoods are harder than some hardwoods.

Hardwoods have beautiful grain patterns and can be used to make fine furniture. Some hardwoods have large pores and must be treated with a paste or liquid called *filler* before being covered with a finish. Wood to be finished with paint does not need a fancy grain to be attractive because the paint covers the pattern. Hardwoods used in woodworking include birch, mahogany, maple, oak, and walnut.

Most softwoods can easily be sawed, planed, chiseled, or bored. They are used mainly for structural work, but such softwoods as Douglas fir, ponderosa pine, red cedar, and white pine can be used for woodworking and furniture.

Hardwood or softwood can also be used to make a type of manufactured board called *plywood*. Plywood consists of an odd number of thin layers of wood glued together. It is lightweight and strong and can be purchased in many sizes and wood patterns. W. Carlisle Anderson

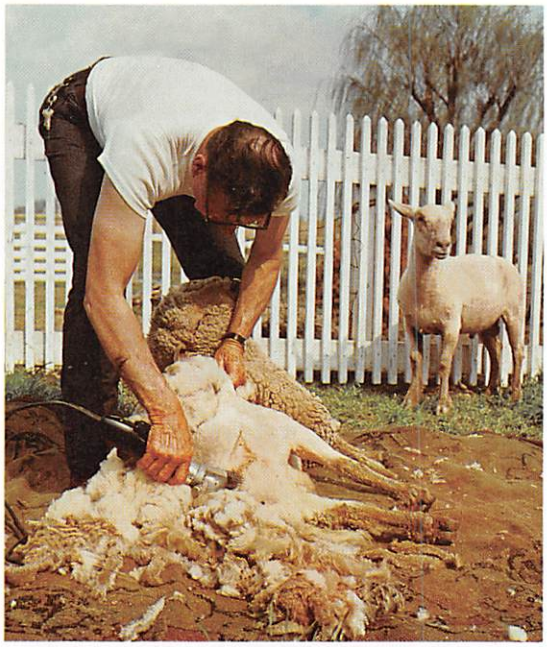
See also Plywood; Saw; Wood; Wood Carving.

WOODWORTH, ROBERT SESSIONS (1869-1962), was an American psychologist known for his work in experimental psychology. Woodworth also worked in the fields of learning, physiological psychology, psychophysics, and testing. He believed that the study of individual behavior should concentrate on physical as well as mental activities.

Woodworth was born in Belchertown, Mass. He graduated from Amherst College in 1891 and entered Harvard University in 1895. At Harvard he studied with the famous psychologist William James and received an M.A. in 1897. In 1899, Woodworth earned a Ph.D. from Columbia University and joined the Columbia faculty. In 1903, Woodworth studied physiology in Liverpool, England with Sir Charles S. Sherrington. He returned to the United States in the same year, and rejoined the faculty at Columbia. Woodworth taught there until 1958. Robert G. Weyant

WOODY NIGHTSHADE. See Bittersweet.

WOOF. See Weaving.



Grant Hellman

Sheep Shearers use power clippers to remove a fleece. An expert shearer can clip 200 or more sheep a day. In most parts of the world, sheep are sheared once a year.

WOOL is a fiber that comes from the fleece of sheep and some other animals. It is made into durable fabrics used in manufacturing blankets, clothing, rugs, and other items. Wool fabrics clean easily, and they resist wrinkles and hold their shape well. Wool also absorbs moisture and insulates against both cold and heat. All these features make wool popular for coats, sweaters, gloves, socks, and other clothing.

Wool fibers are nearly cylindrical in shape. Overlapping scales on the surface make the fibers mat and interlock under heat, moisture, and pressure. This property of wool fibers is called *felting*. Felting increases the strength and durability of wool fabrics. It also enables wool to be made into felt. See FIBER (picture: Wool Fibers).

The Wool Products Labeling Act of 1939 established guidelines in the United States for defining and labeling wool products. This law defines wool as the fiber from the fleece of sheep. It also includes such fibers as alpaca, from alpacas; camel's hair; cashmere, from Cashmere goats; mohair, from Angora goats; and vicuña, from vicuñas.

Worldwide production of raw wool totals about $5\frac{3}{4}$ billion pounds (2.6 billion kilograms) annually. The leading wool-producing nations are Australia, Russia, New Zealand, Argentina, and South Africa, in that order. Every state in the United States except Hawaii produces some wool. Texas is the leading producer, followed by Wyoming, California, Colorado, and South Dakota, in that order. The United States uses more wool than it produces, and so it imports some wool.

Sources of Wool. Almost all wool comes from sheep. These animals—and their wool—are classified into five groups, depending on the quality of the fleece. The five classes of wool, listed here in order of quality, are (1) fine wool, (2) crossbred wool, (3) medium wool, (4) long wool, and (5) coarse wool, or carpet wool.

Fine-Wooled Sheep include the Merino and other breeds with Merino ancestry, such as the Debouillet and the Rambouillet. These sheep produce the finest wool, which is used in making high-quality clothing.

Crossbred-Wooled Sheep, such as the Columbia and Corriedale, are crossbreeds of fine- and long-wooled breeds. Their wool is used for rugged clothing.

Leading Wool-Producing States

Wool clipped from sheep in 1977

Texas	21,000,000 lbs. (9,525,440 kg)
Wyoming	10,880,000 lbs. (4,935,090 kg)
California	9,925,000 lbs. (4,501,900 kg)
Colorado	8,809,000 lbs. (3,995,700 kg)
South Dakota	6,236,000 lbs. (2,828,600 kg)
Utah	5,453,000 lbs. (2,473,400 kg)
Idaho	5,281,000 lbs. (2,395,400 kg)
New Mexico	4,656,000 lbs. (2,111,900 kg)
Montana	4,462,000 lbs. (2,023,900 kg)
Oregon	3,401,000 lbs. (1,542,700 kg)

Source: *Wool and Mohair*, March 1978, U.S. Dept. of Agriculture.

Leading Wool-Producing Countries

Wool clipped from sheep in 1977

Australia	1,549,000,000 lbs. (702,610,000 kg)
Russia	1,010,000,000 lbs. (458,100,000 kg)
New Zealand	666,898,000 lbs. (302,499,900 kg)
Argentina	368,172,000 lbs. (167,000,000 kg)
South Africa	243,611,000 lbs. (110,500,100 kg)
Uruguay	138,009,000 lbs. (62,599,830 kg)
China	136,687,000 lbs. (62,000,180 kg)
Turkey	120,152,000 lbs. (54,500,030 kg)
United States	110,231,000 lbs. (49,999,940 kg)
Great Britain	103,397,000 lbs. (46,900,090 kg)

Source: *Production Yearbook, 1977*, FAO.